Math CAMPPP 2012

Supporting Students with Learning Disabilities in Mathematics

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Myth or Truth?

- Students with learning disabilities have average intelligence.

http://www.adnetonline.org/.cWtools/download.php/mnF=LD%20Myths%20Facts.pdf,mnOD=LD%20Resources,mnOD=Learning%20Disabilities,mnOD=Topics,mnOD=Information,mnOD=HTML,mnOD=My%20Documents,dc=adnet,dc=mennonite,dc=net

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Myth or Truth?

- Students with learning disabilities are lazy.

http://www.adnetonline.org/.cWtools/download.php/mnF=LD%20Myths%20Facts.pdf,mnOD=LD%20Resources,mnOD=Learning%20Disabilities,mnOD=Topics,mnOD=Information,mnOD=HTML,mnOD=My%20Documents,dc=adnet,dc=mennonite,dc=net

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Myth or Truth?

- With effort, most students can out-grow their learning disabilities.

http://www.adnetonline.org/.cWtools/download.php/mnF=LD%20Myths%20Facts.pdf,mnOD=LD%20Resources,mnOD=Learning%20Disabilities,mnOD=Topics,mnOD=Information,mnOD=HTML,mnOD=My%20Documents,dc=adnet,dc=mennonite,dc=net

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Myth or Truth?

- Accommodations listed in individual education plans give students with learning disabilities an unfair advantage [in mathematics].

http://www.adnetonline.org/.cWtools/download.php/mnF=LD%20Myths%20Facts.pdf,mnOD=LD%20Resources,mnOD=Learning%20Disabilities,mnOD=Topics,mnOD=Information,mnOD=HTML,mnOD=My%20Documents,dc=adnet,dc=mennonite,dc=net

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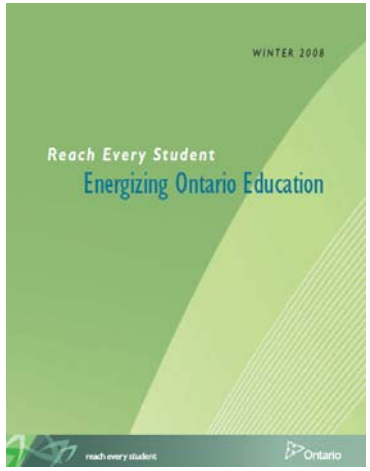
Energizing Ontario Education

Our commitment is to every student. This means …. [ensuring] that we develop strategies to help every student learn, no matter their personal circumstances.



Reach Every Student: Energizing Ontario Education, 2008

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Human Rights Code

*The Human Rights Code provides for **the right to equal treatment with respect to services**, without discrimination on the basis of a number of grounds, **including disability**.*

*Education is considered to be a service under the code, and service providers have **an obligation to accommodate a person's needs**…persons with disabilities should be considered, assessed, and accommodated on an individual basis.*

The Individual Education Plan: A Resource Guide (2004)

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Goals for Today

- increase empathy for students with learning disabilities by developing an understanding of the cognitive processes + executive functioning
- explore the impact of these processes on the teaching and learning of mathematics
- select instructional and assessment strategies to increase success for students with learning disabilities

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Understanding the Profile of Exceptional Learners

The Cognitive Processes + Executive Functioning

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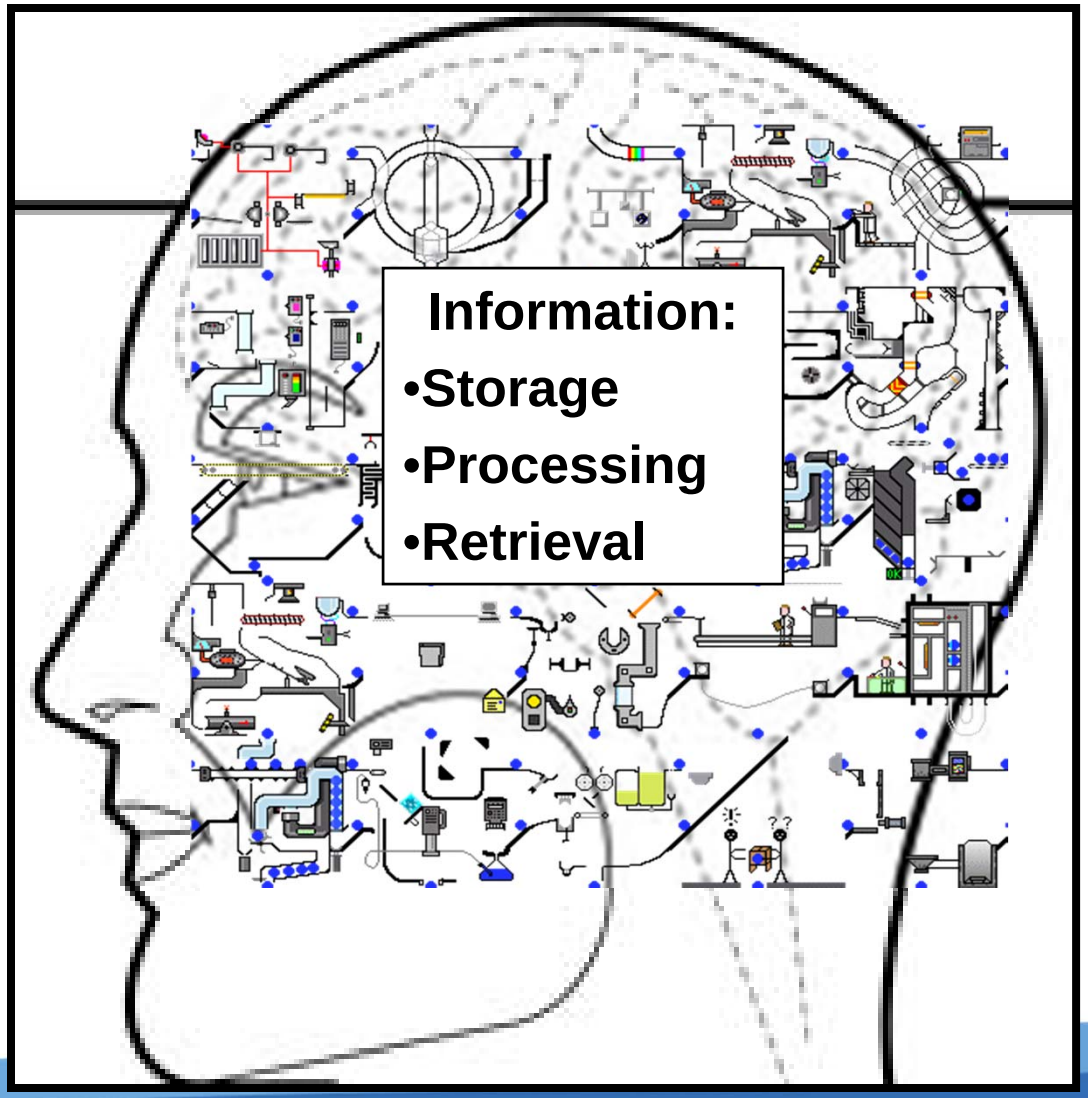
The Cognitive Processes and Learning

Information In



Information Out

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Cognitive Ability is Measured in 4 Domains

Verbal Comprehension

Perceptual Reasoning

Memory

Processing Speed

Cognitive Processes

+ Executive Functioning

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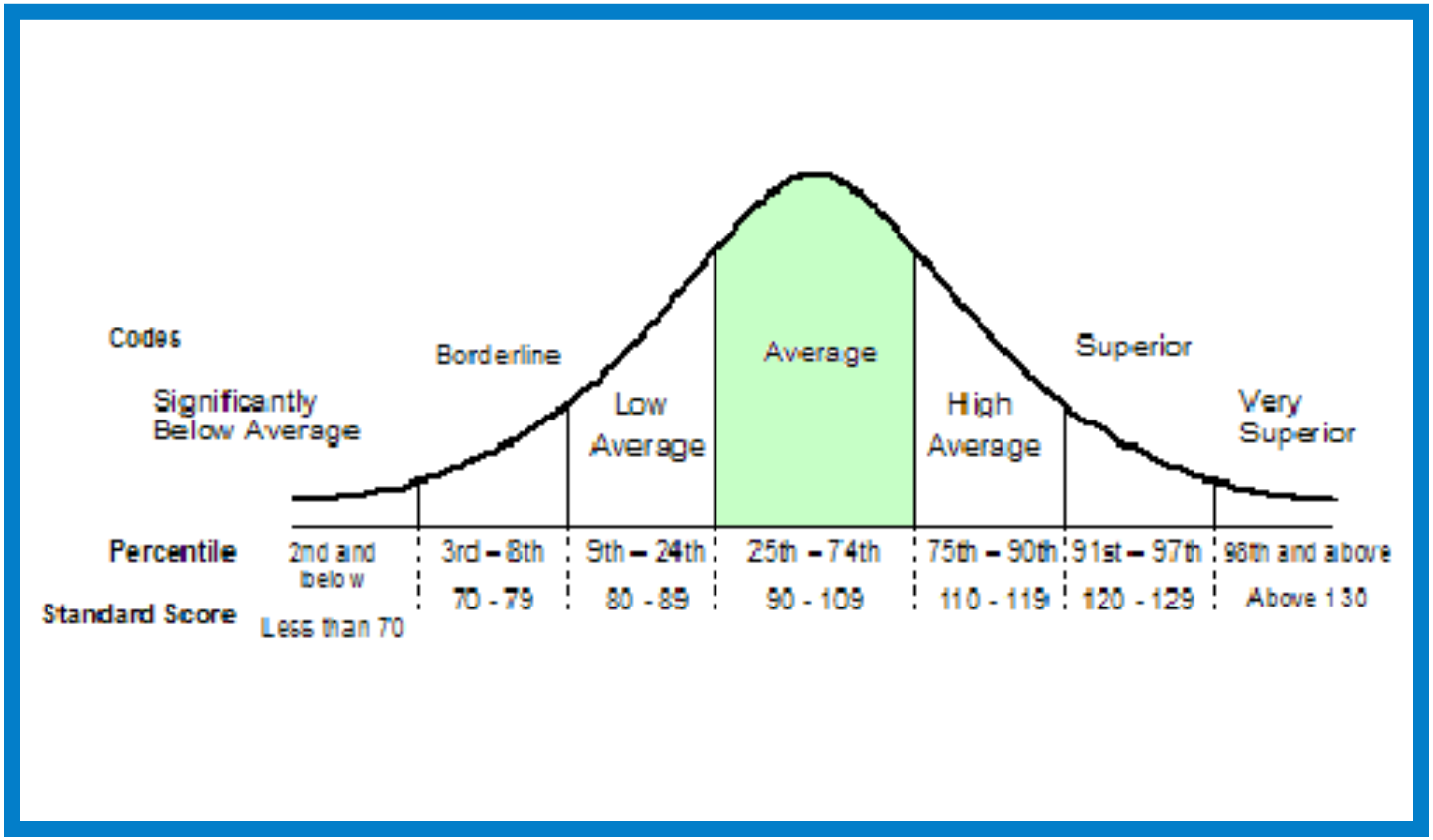
Normal Distribution Curve



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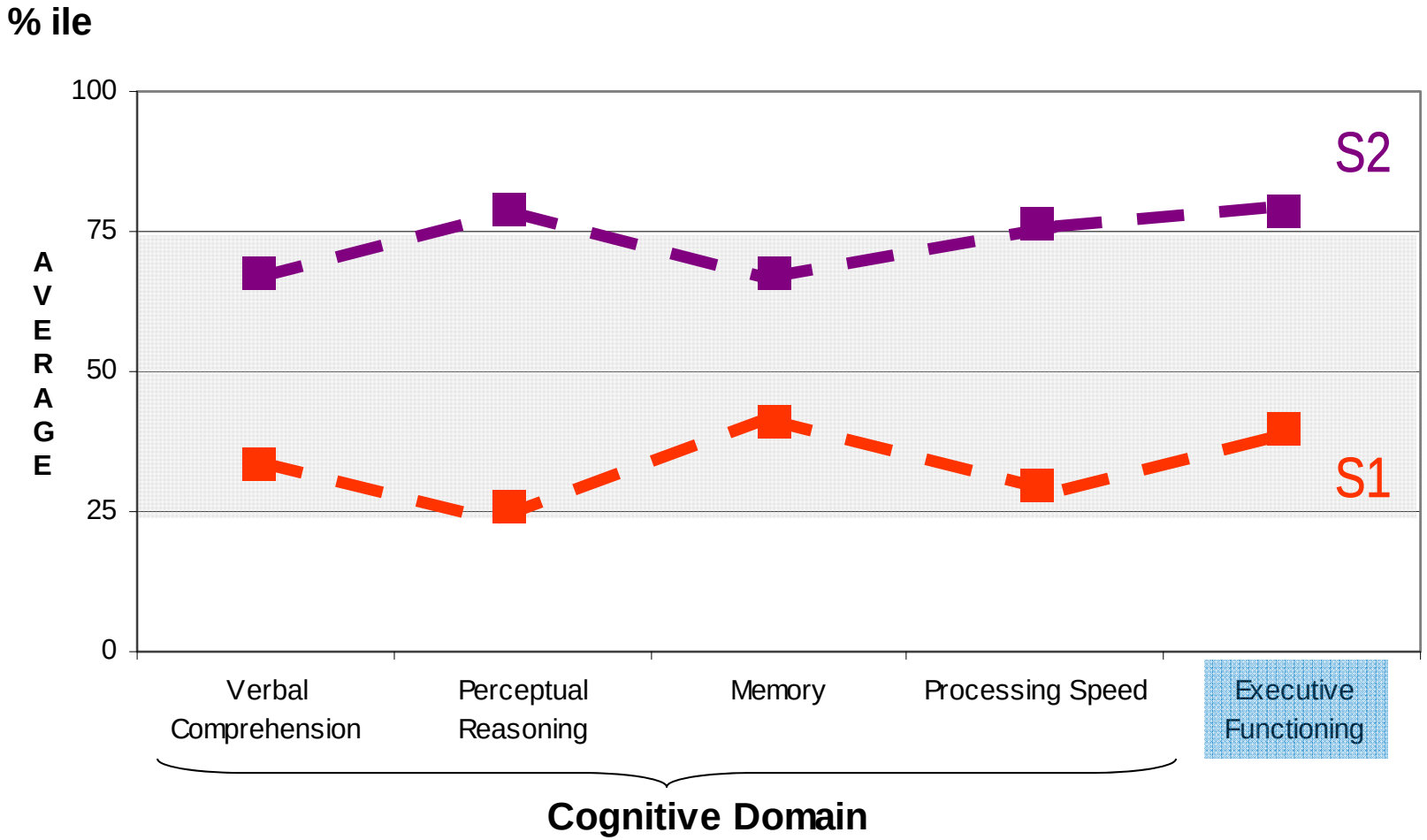
Sample Profile: Individual with Average Cognitive Ability



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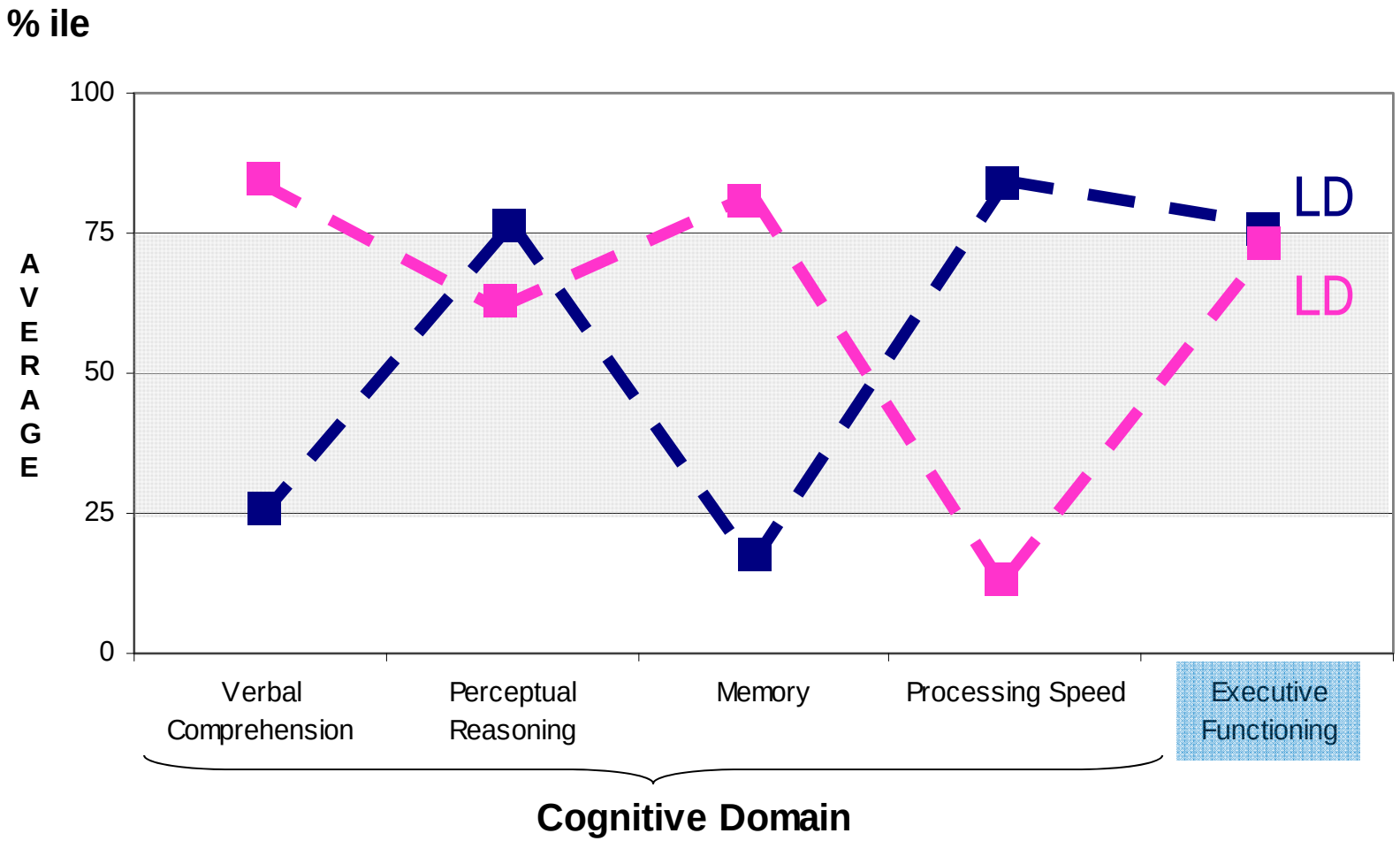
Sample Profile: Individual with a Learning Disability



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Profile: Student with a Learning Disability

- Over-all average to above average intelligence, i.e. the potential to learn
- May have difficulty with input or output
- May have difficulty with information processing, storage or retrieval
- Academic Achievement may not be reflective of ability

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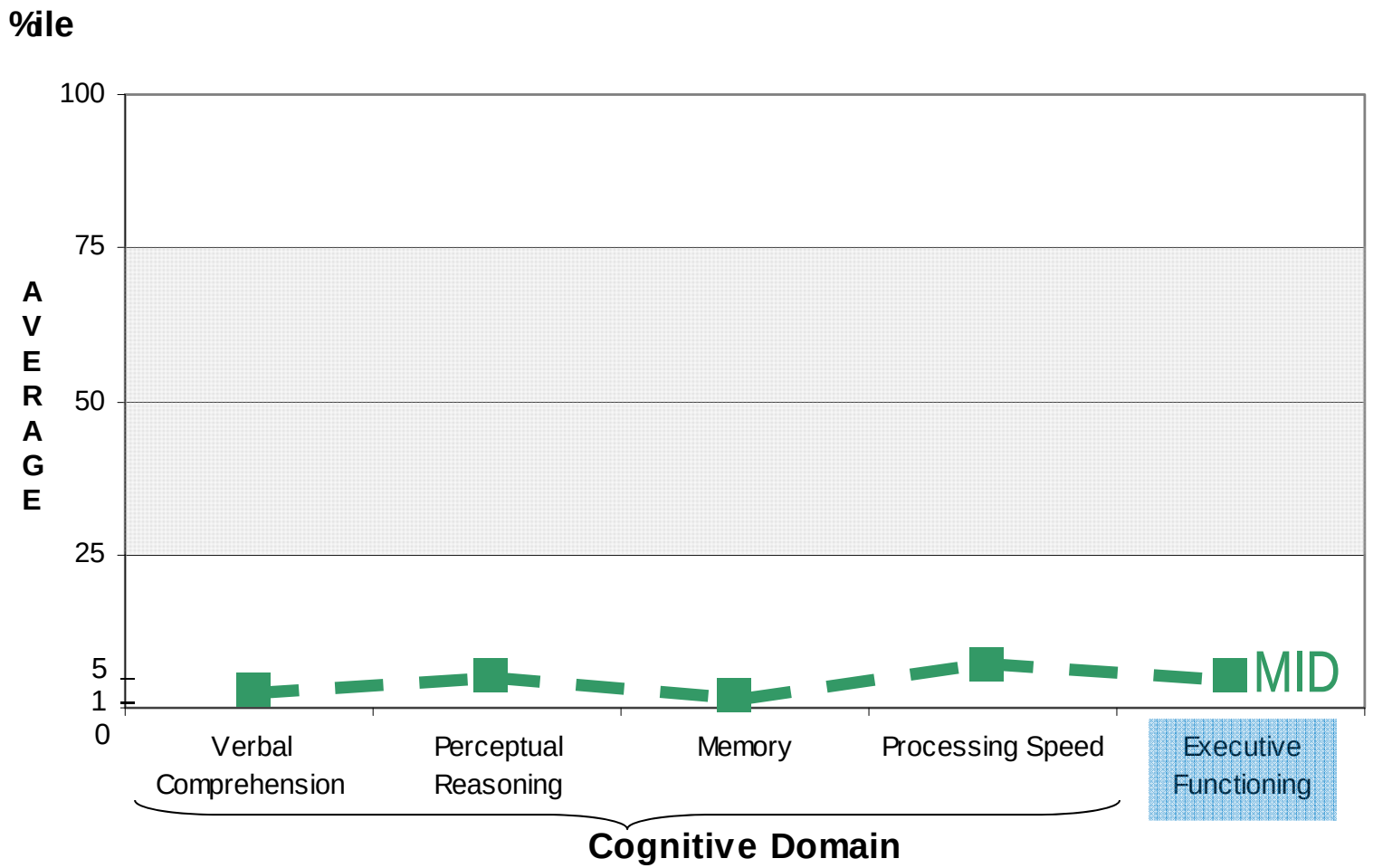
Sample Profile: Individual with a Mild Intellectual Disability



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Profile: Student with a Mild Intellectual Disability

- Overall Cognitive ability from 1st to 5th % ile
- Delays in all areas of cognitive development
- Delays in adaptive skills
- Difficulty understanding abstract concepts
- **Potential for academic learning, independent social adjustment and economic self-support**

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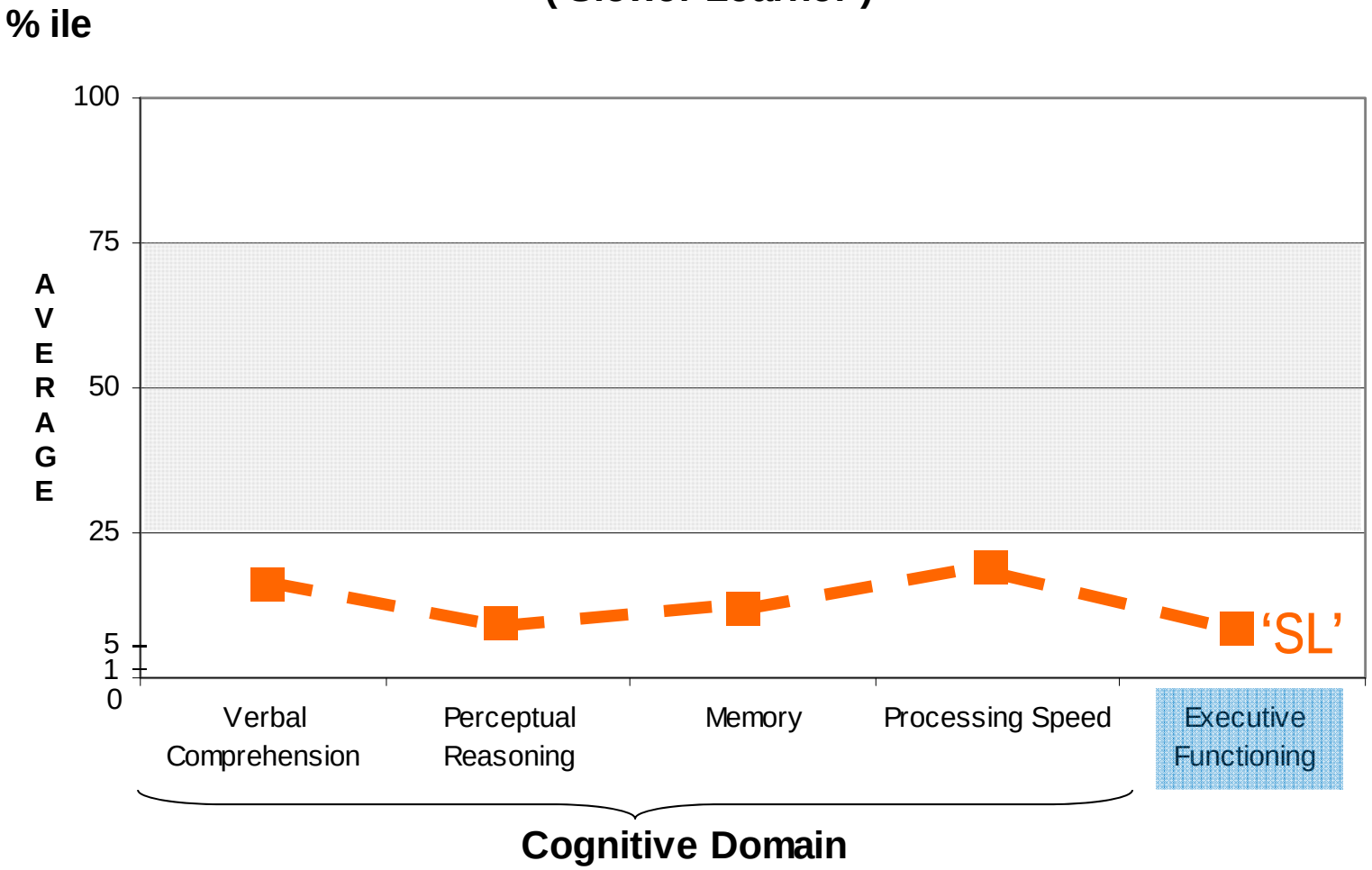
Sample Profile: Individual with Below Average Cognitive Ability ('Slower Learner')



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Profile: Student with Below Average Cognitive Ability ('Slower Learner')

- People who learn at a slower rate are cognitively functioning between the 6th and 24th percentiles

- People who function within the range of slower learners have average to low-average adaptive skills

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Simulations

Understanding the Cognitive Processes + Executive Functioning
through a Mathematical Lens

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VERBAL COMPREHENSION

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Imagine a student reading this…

Usually, we tend to associate increasing rates with graphs that become “steeper”. This is correct when the function is increasing itself and the slopes are positive. However, when the function is decreasing and the slopes are negative, the increase of the steepness of the graph means that the magnitude of the slope increases, thus, the number becomes “more negative” and the actual value of the slope is decreasing.

How do you feel...

Make a shape using 3 ***identical*** blocks.

Point to one of your blocks.

What fraction of the shape is this block?

Nelson Mathematics 2, Chapter 12, Chapter Interview, Interview Questions / Prompts

*I compared the distance to the time using a **rate**. I wrote a **proportion** with a missing **term** for the distance travelled in 1 hr. The **scale factor** is 3 because 3 ÷ 3 = 1. So, I divided 240 by 3 to get the missing **term**.*

Nelson Mathematics 7, p. 47

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Verbal Comprehension

Verbal comprehension involves:

- the ability to take in and comprehend verbal material presented orally and in writing
- formulating ideas in thinking and expressing them orally and in writing

PERCEPTUAL REASONING

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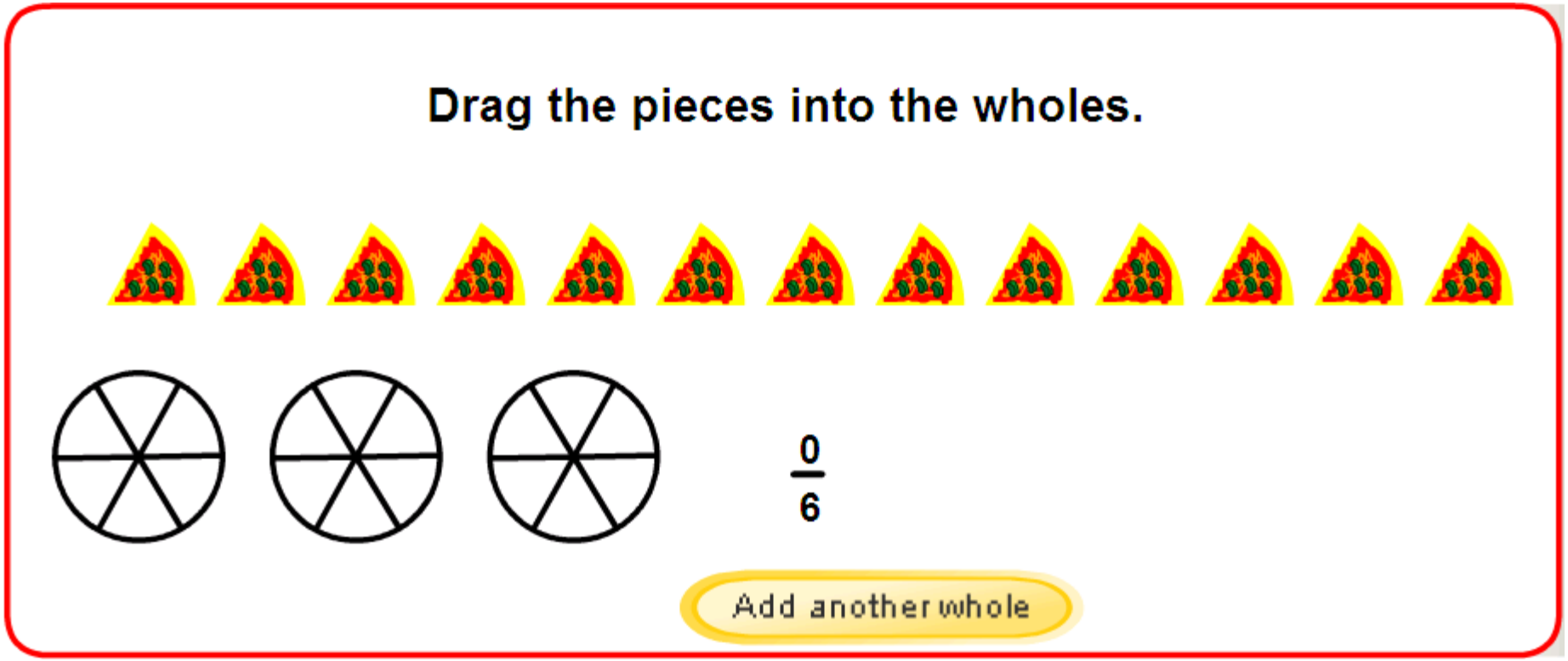
What We See…



Math CLIPS, Exploring Part / Whole Relationships, CLIP 5: Representing Improper Fractions as Mixed Numbers , 5.2 Leftovers, Scene 5

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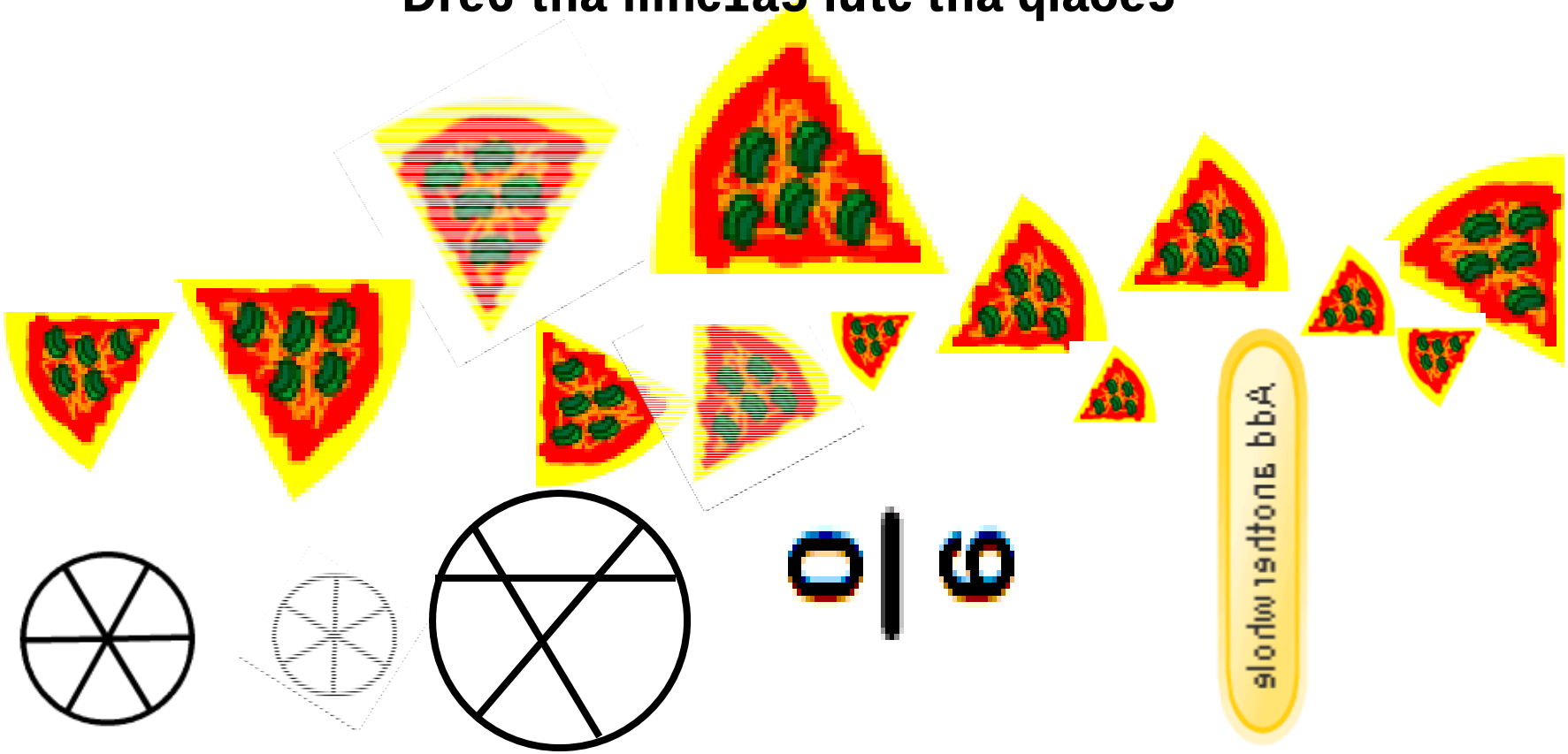
What a Student Might See…

Dre6 tha mhc1a5 iutc tha qiaoe5



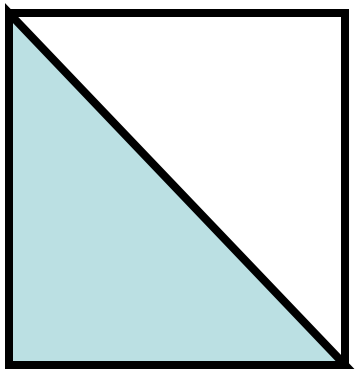
b d p q

h n u m w

c o e a

6 9 3 8 2 5

1 l 6 b 2 Z 5 S



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Thraa 5tnbaut5 aeoh raoaivab e wabinw-5i2ab qi22e.
Lnka eta Zl3 cf hi5 qi22e.
Ji11 eta VZ cf har qi22e.
5e6e eta ZlS cf har qi22e.
Mhc eta wcra qi22e?

Student with weakness in Perceptual Reasoning might experience this . . .

And we think we have asked them to read this . . .

Three students each received a medium-sized pizza.
Luke ate 5/8 of his pizza.
Jill ate 1/2 of her pizza.
Saba ate 2/5 of her pizza.
Who ate more pizza?

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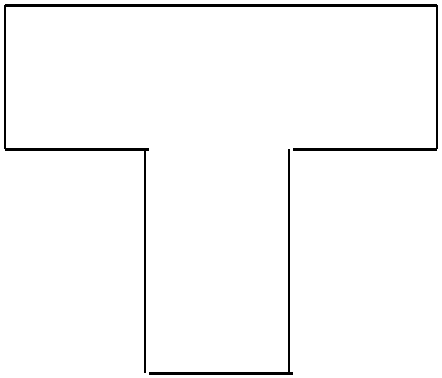
From Part to Whole

If this figure represents $\frac{3}{5}$, draw the whole.



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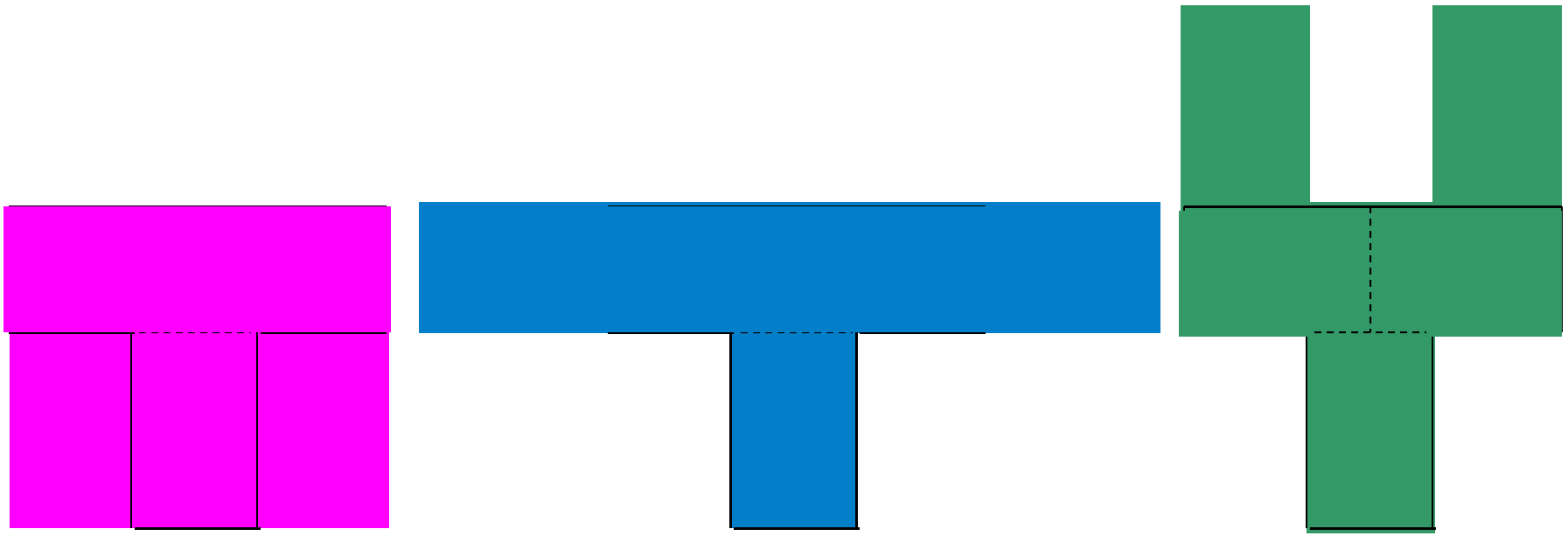
Visualizing the Whole



Perceptual Reasoning

Perceptual reasoning involves:

- the ability understand visual-spatial information, such as part-whole relations, patterns and sequences
- the ability to generate visual representations in the mind, problem-solve and present ideas in a visual format

YCDSB Supporting Students with Learning Disabilities in Mathematics (2012)

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MEMORY

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What's My Fraction?

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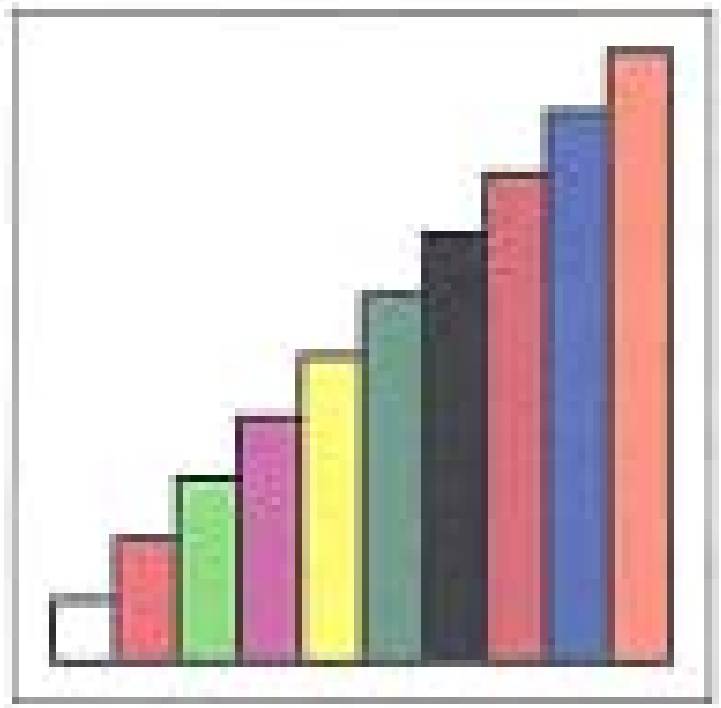
Introducing Cuisenaire Rods



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Represent the following fractions.

- If the orange rod has a value of 1 whole, what fraction would you use to describe the…
  - white rod
  - purple rod
  - brown rod

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Types of Memory

- Verbal
- Visual

- Short Term
- Long Term
- Working

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Memory

Memory:

- involves working memory, short-term and long-term memory
- working memory is the ability to hold information in the mind for processing / manipulating

PROCESSING SPEED / VISUAL MOTOR INTEGRATION

A Modelled Example

$$\frac{(x^2+5x+6)(x^2-x-12)}{x^4-3x^3-10x^2+24x}$$

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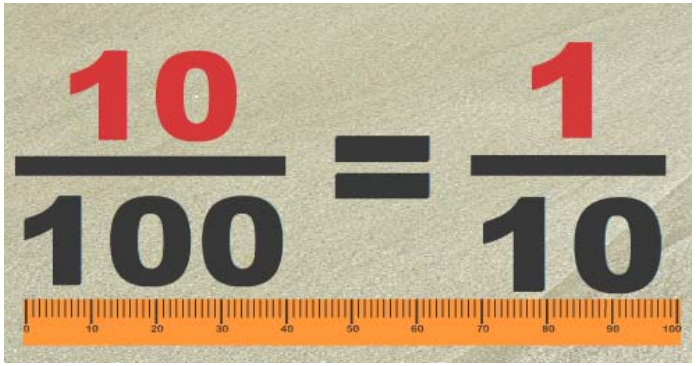
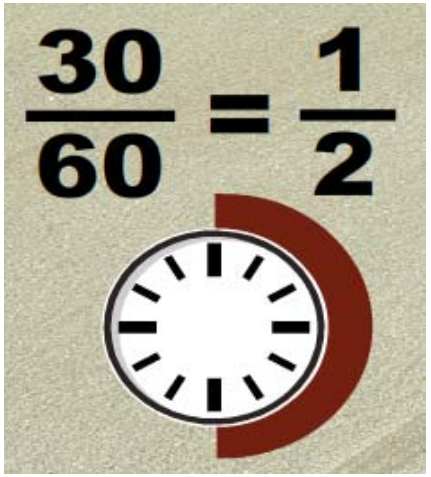
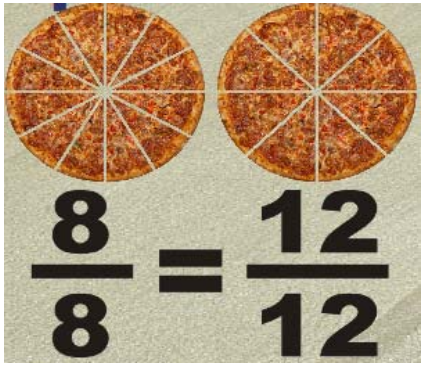
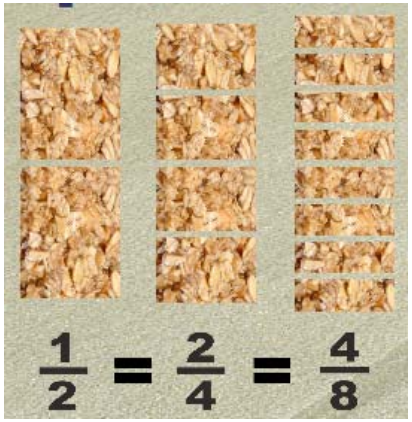
Different Representations

What is the same / different about these representations?









Images drawn from *Math CLIPS, Exploring Part / Whole Relationships, CLIP 2: Forming and Naming Equivalent Fractions, Activity 2.1: Recognizing Equivalent Fractions, Scene 2*

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Processing Speed / Visual-Motor Integration

Processing Speed and **Visual Motor Integration** involves:

- Processing speed is the ability to perform simple visual tasks quickly and accurately. It may apply to processing of other types of information
- Visual motor integration is the ability to coordinate visual input and physical movement to movements to produce written work accurately

EXECUTIVE FUNCTIONING

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Representing Fractions

- Use the adding machine tape provided to create a number line. Label the following fractions on your number line:

$$\frac{4}{5}, \frac{3}{8}, \frac{9}{6}, \frac{1}{3}, \frac{7}{12}$$

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Executive Functioning

Executive Functioning involves

- mental processes that draw on past experiences in order to successfully complete a task
- planning, organizing, strategizing, focusing attention, self-monitoring, self-regulating, and managing time and space

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Solving a Problem

The 15 km Charity Walk-a-thon has

- a trail mix station every two thirds of a kilometre;
- a water station every three fourths of a kilometre; and
- a cooling station every three halves of a kilometre.

Ayan has reached the first water station, Mark is at the first cooling station, and Angele is at the second trail mix station.

Who has walked the farthest?

Nelson Mathematics 6, p. 358

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Middle Years Collaborative Inquiry Research Project

YCDSB in Partnership with Lakehead University and Trent University

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Research Questions

- *How does understanding of content knowledge [for teaching] mathematics, and how students with learning disabilities learn this content, support teachers of mathematics in planning for instruction and assessment?*

- *What is the effect of these understandings on practice and related student achievement in mathematics?*

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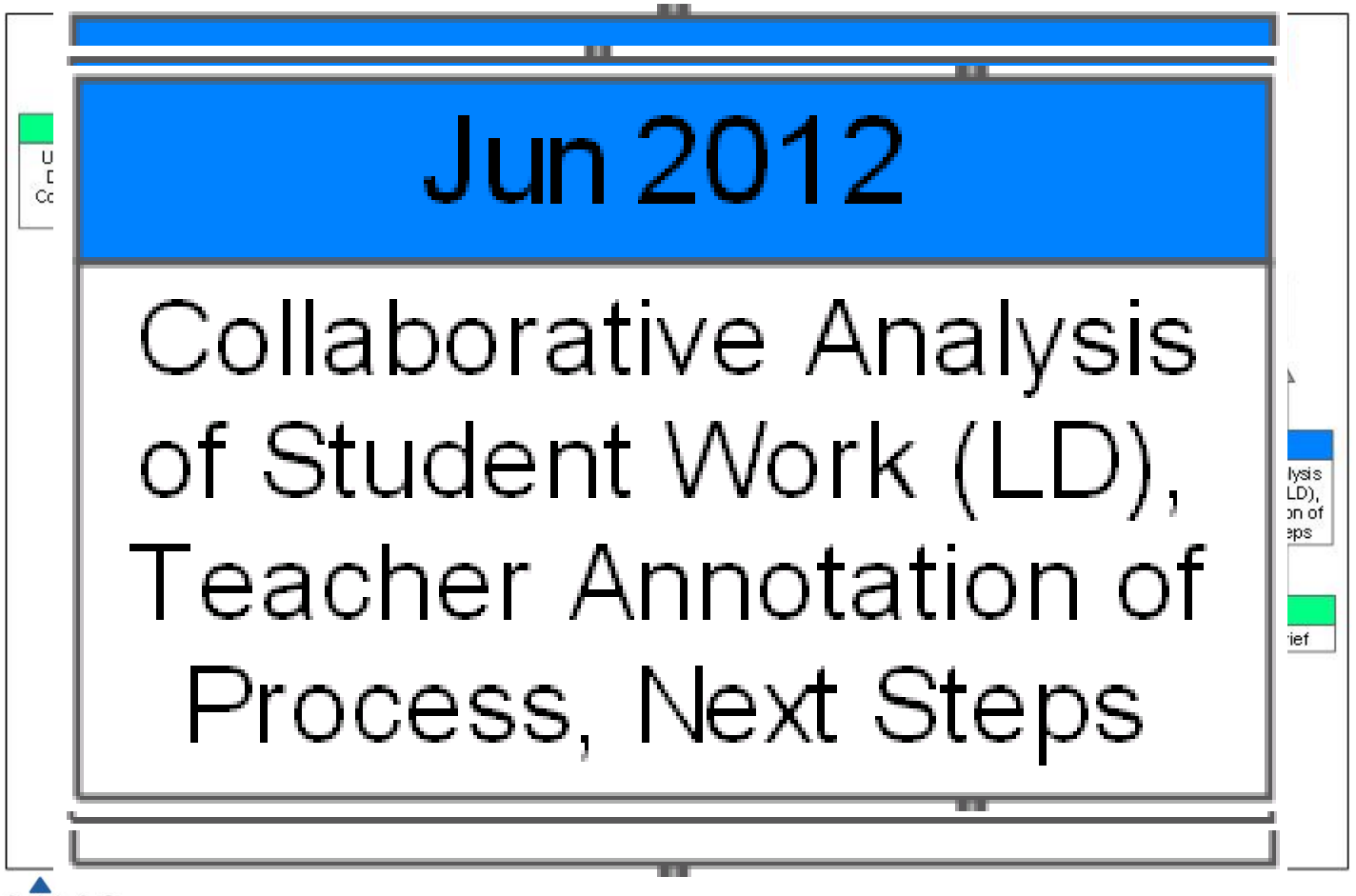
Process and Timelines



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Supporting Students with Learning Disabilities in Mathematics

A YCDSB Resource

Individual Education Plan

I
E
P

Inclusion Engagement Performance

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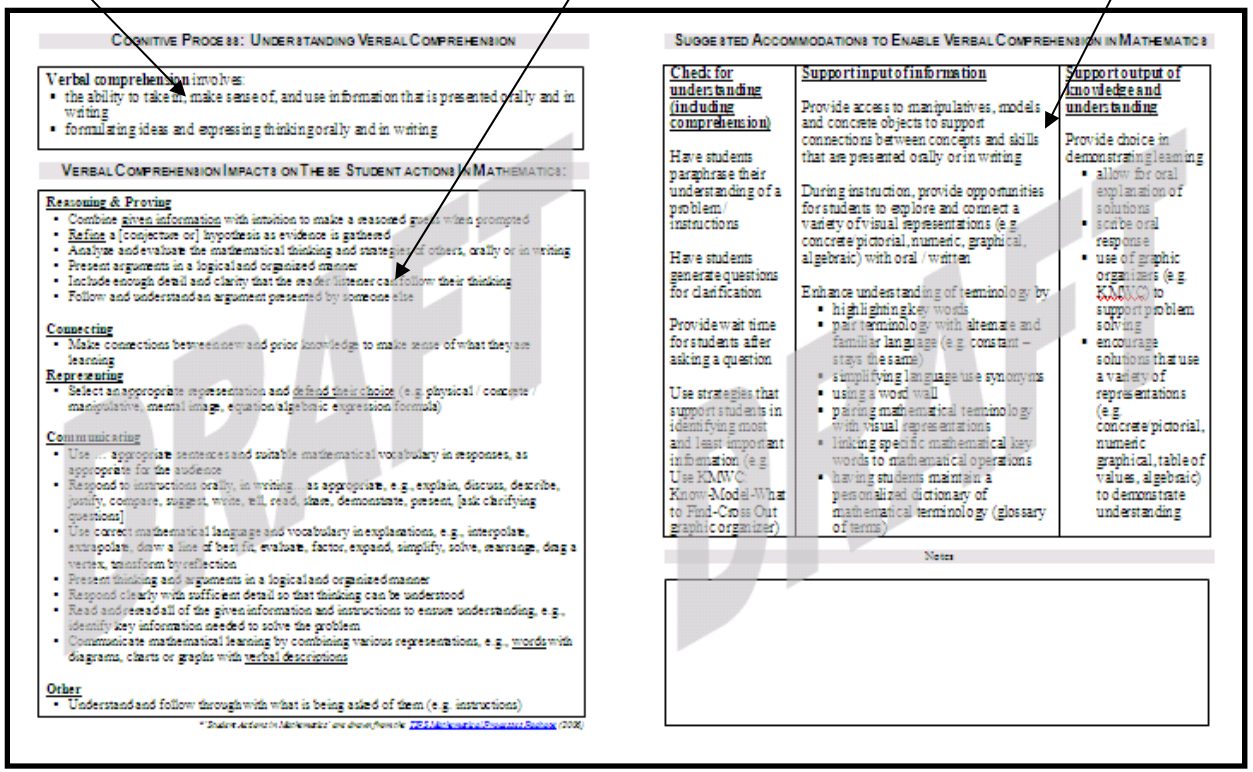
Format of Document

Description of cognitive process

Related Student Actions reflecting the Mathematical Processes

Suggested Accommodations



COGNITIVE PROCESS: UNDERSTANDING VERBAL COMPREHENSION

Verbal comprehension involves:
- the ability to take in, make sense of, and use information that is presented orally and in writing
- formulating ideas and expressing thinking orally and in writing

VERBAL COMPREHENSION IMPACTS ON THESE STUDENT ACTIONS IN MATHEMATICS:

Reasoning & Proving
- Combine given information with intuition to make a reasoned guess when prompted
- Refine a [conjecture or] hypothesis as evidence is gathered
- Analyze and evaluate the mathematical thinking and strategies of others, orally or in writing
- Present arguments in a logical and organized manner
- Include enough detail and clarity that the reader/listener can follow their thinking
- Follow and understand an argument presented by someone else

Connecting
- Make connections between new and prior knowledge to make sense of what they are learning

Representing
- Select an appropriate representation and defend their choice (e.g. physical / concrete / manipulative, mental image, equation/algebraic expression/formula)

Communicating
- Use ... appropriate sentences and suitable mathematical vocabulary in responses, as appropriate for the audience
- Respond to instructions orally, in writing ...as appropriate, e.g., explain, discuss, describe, justify, compare, suggest, write, tell, read, share, demonstrate, present, [ask clarifying questions]
- Use correct mathematical language and vocabulary in explanations, e.g., interpolate, extrapolate, draw a line of best fit, evaluate, factor, expand, simplify, solve, rearrange, drag a vertex, transform by reflection
- Present thinking and arguments in a logical and organized manner
- Respond clearly with sufficient detail so that thinking can be understood
- Read and reread all of the given information and instructions to ensure understanding, e.g., identify key information needed to solve the problem
- Communicate mathematical learning by combining various representations, e.g., words with diagrams, charts or graphs with verbal descriptions

Other
- Understand and follow through with what is being asked of them (e.g. instructions)

* *Student Actions in Mathematics* are drawn from the [TCDSB Mathematics Parameters Support] (2008)

SUGGESTED ACCOMMODATIONS TO ENABLE VERBAL COMPREHENSION IN MATHEMATICS

Check for understanding (including comprehension)	Support input of information	Support output of knowledge and understanding
Have students paraphrase their understanding of a problem / instructions Have students generate questions for clarification Provide wait time for students after asking a question Use strategies that support students in identifying most and least important information (e.g. Use KMWC: Know-Model-What to Find-Cross Out graphic organizer)	Provide access to manipulatives, models and concrete objects to support connections between concepts and skills that are presented orally or in writing During instruction, provide opportunities for students to explore and connect a variety of visual representations (e.g. concrete/pictorial, numeric, graphical, algebraic) with oral / written Enhance understanding of terminology by ▪ highlighting key words ▪ pair terminology with alternate and familiar language (e.g. constant – stays the same) ▪ simplifying language use synonyms ▪ using a word wall ▪ pairing mathematical terminology with visual representations ▪ linking specific mathematical key words to mathematical operations ▪ having students maintain a personalized dictionary of mathematical terminology (glossary of terms)	Provide choice in demonstrating learning ▪ allow for oral explanation of solutions ▪ scribe oral response ▪ use of graphic organizers (e.g. KMWC) to support problem solving ▪ encourage solutions that use a variety of representations (e.g. concrete/pictorial, numeric graphical, table of values, algebraic) to demonstrate understanding

Notes

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Collaborative Work

Supporting Students with Learning Disabilities, <<Grade>>
<<Names, (school)>>
<<System Person, title>>

Student Name	Modified math level	Relative Strengths	Areas of Difficulty	Potential Accommodations
		–	–	–
		–	–	–
		–	–	–
		–	–	–
		–	–	–
		–	–	–
		–	–	–

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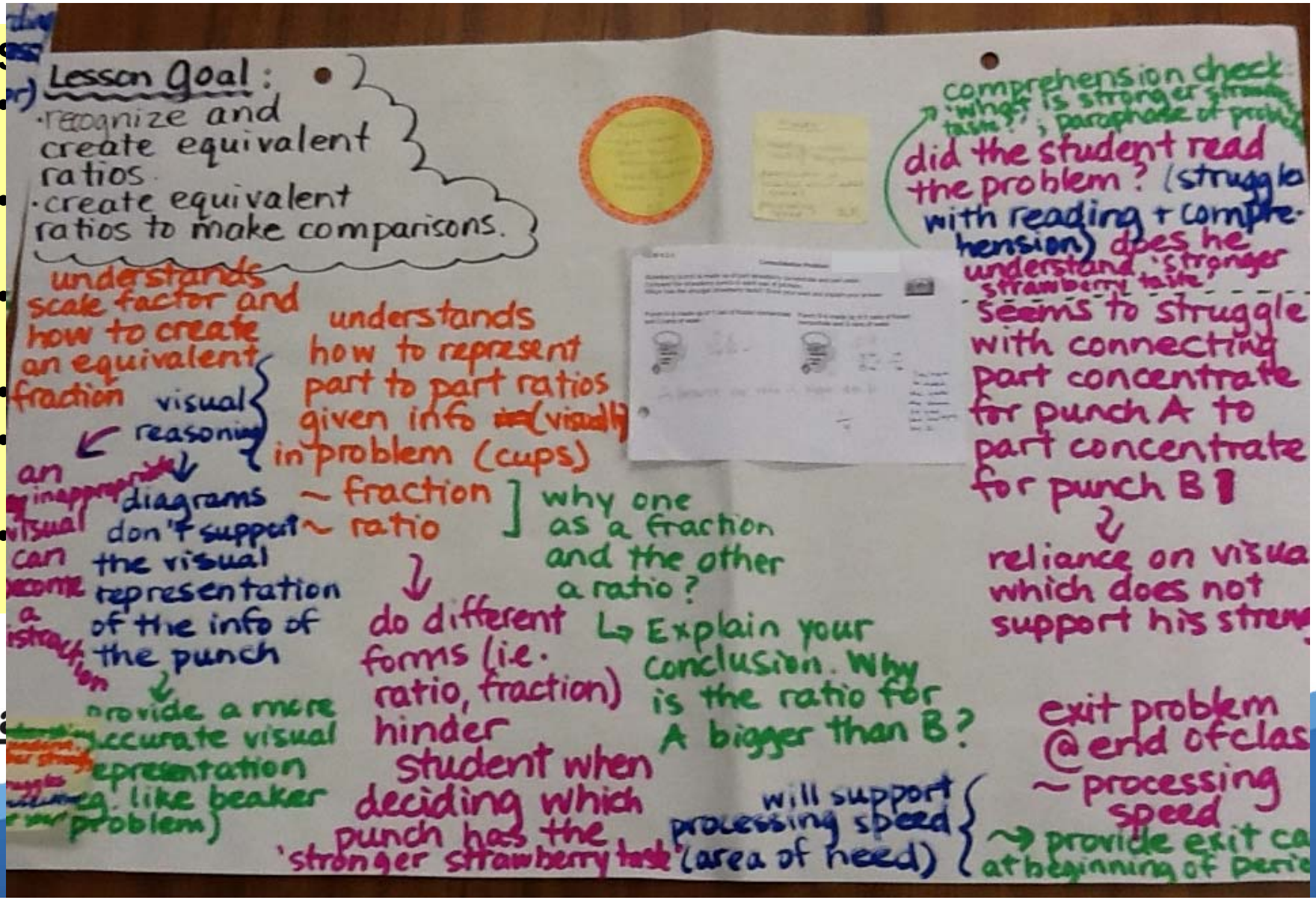
Collaborative Work



Making Connections between Mathematical Understanding and Learning Disability Profiles

Math CAMPPP 2012: Collaborative Analysis of Student Learning (Video)
Making Connections between Student Mathematical Understandings and Learning Disability Profiles

Refer the YCDSB *Supporting Students with Learning Disabilities* document as you view each student video and consider the following questions.

Student A: Strengths, as listed in IEP	Student A: Needs, as listed in IEP
– Perceptual reasoning – Mathematics; operations and reasoning – Visual memory – Working memory – Processing speed – Visual learning style	– Verbal comprehension (relative) – Reading; decoding and comprehension – Listening comprehension – Verbal memory

What mathematical understandings are evident?	How are these understandings connected to the IEP profile?
What partial / transitional understandings are evident?	How are these partial / transitional understandings connected to the IEP profile?
What next steps (probing questions / descriptive feedback / activities) would you suggest for this student?	How will these next steps support the student based on their IEP profile?

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Making Connections between Mathematical Understanding and Learning Disability Profiles

Student A: Grade 7, LD diagnosis

Video

- Strengths, as listed in IEP:
  - Perceptual reasoning
  - Mathematics; operations and reasoning
  - Visual memory
  - Working memory
  - Processing speed
  - Visual learning style
- Needs, as listed in IEP:
  - Verbal comprehension (relative)
  - Reading; decoding and comprehension
  - Listening comprehension
  - Verbal memory

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Some Preliminary Findings

- Teachers persisting to ‘uncover’ student mathematical understanding and consider next steps based student strengths and needs.

Making Connections between Mathematical Understanding and Learning Disability Profiles

Student B, Grade 7, LD diagnosis

Video

- Strengths, as listed in IEP:
  - Perceptual reasoning
  - Working memory
  - Processing speed
  - Visual motor integration
  - Visual learning style
  - *Academic Assessment: Expressive and receptive language, applied problem solving*
- Needs, as listed in IEP:
  - Verbal comprehension
  - Math calculation (relative)
  - Word recognition, reading fluency
  - Phonemic decoding (automatic)
  - Visual tracking
  - Comprehension of text

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Some Preliminary Findings

- Teachers paying attention to student strengths, as well as precision and context when stating mathematical generalizations.

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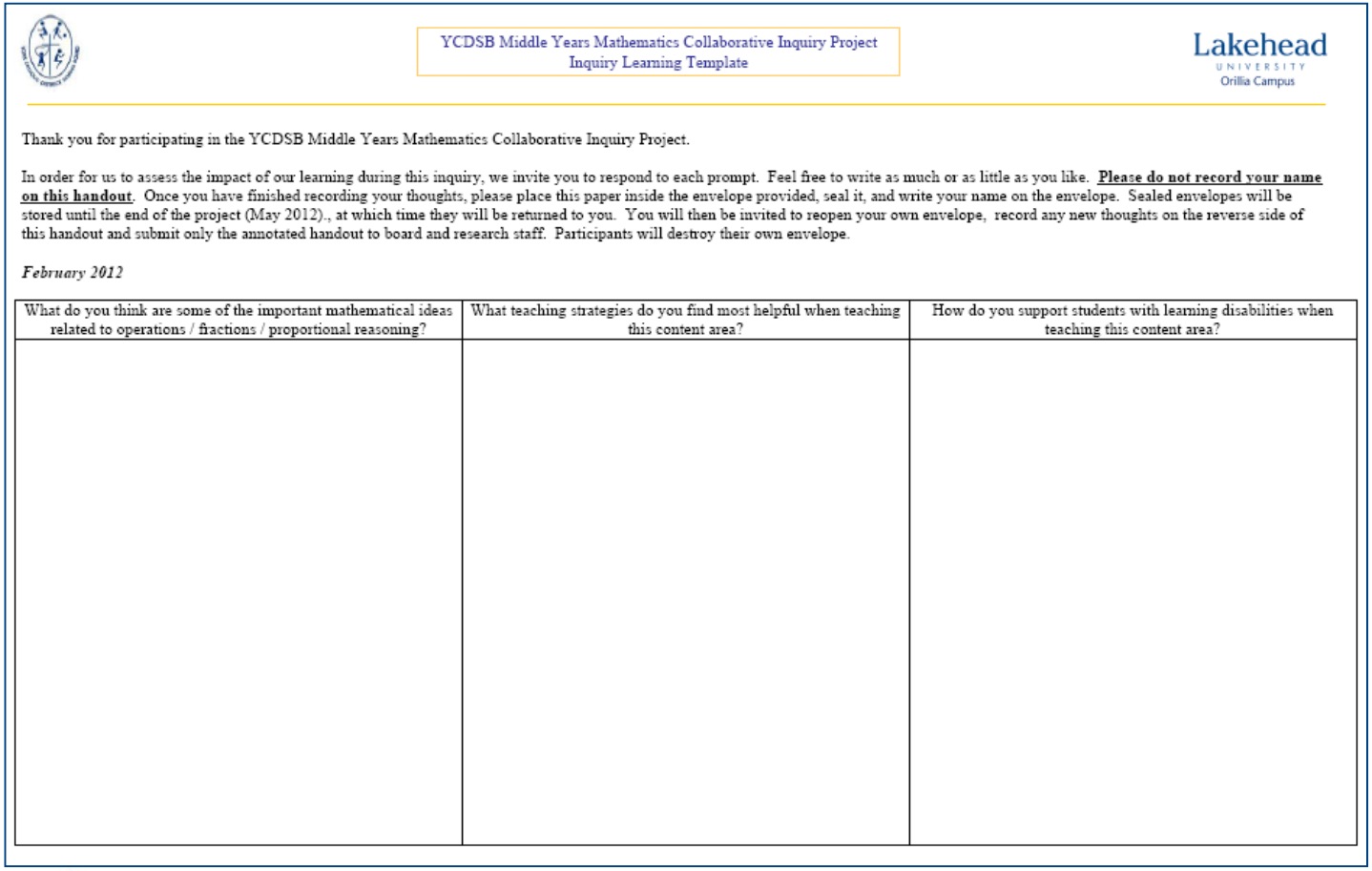
Teacher Inquiry Learning Template



YCDSB Middle Years Mathematics Collaborative Inquiry Project
Inquiry Learning Template

Lakehead UNIVERSITY Orillia Campus

Thank you for participating in the YCDSB Middle Years Mathematics Collaborative Inquiry Project.

In order for us to assess the impact of our learning during this inquiry, we invite you to respond to each prompt. Feel free to write as much or as little as you like. **Please do not record your name on this handout**. Once you have finished recording your thoughts, please place this paper inside the envelope provided, seal it, and write your name on the envelope. Sealed envelopes will be stored until the end of the project (May 2012)., at which time they will be returned to you. You will then be invited to reopen your own envelope, record any new thoughts on the reverse side of this handout and submit only the annotated handout to board and research staff. Participants will destroy their own envelope.

February 2012

What do you think are some of the important mathematical ideas related to operations / fractions / proportional reasoning?	What teaching strategies do you find most helpful when teaching this content area?	How do you support students with learning disabilities when teaching this content area?

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February 2011 / June 2012

Some Preliminary Findings

- Teachers deepening their content knowledge for teaching the content area of focus.

PRE

Multiplication and Division
why are certain processes used?
How are numbers broken down? For example:
3 x 5 = 15
3 x 50 = 150
3 x 500 = 1500
Why?
Students will say 3 x 5 = 15 so 3 x 50 = 150 because you add a zero
Relating multiplication to division

POST

…
Moving to multiplicative thinking
Place value importance
Breaking down of numbers,
e.g. 14 x 5 = 10 x 5 + 4 x 5
Division using friendly numbers
Relationship between multiplication and division

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Some Preliminary Findings

- Teachers deepening their content knowledge for teaching the content area of focus.

PRE
Recognizing if the relationship is part to part or part to whole
…

POST
Recognizing that a situation is a proportional relationship and whether or not it is an example of part-to-part or part-to-whole
…

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Some Preliminary Findings

- Teachers using evidence-based instructional strategies to teach the content area of focus.

PRE

Constant review, modeling, showing students different strategies and approaches that can be utilized

…

POST

Allowing students to share ideas, thoughts, work examples

Bansho is also very useful

Investigating

Collaboration…

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Some Preliminary Findings

- Teachers move from more generic strategies for supporting students with learning disabilities to more inclusive, evidence-based strategies that ~~are good for all but necessary for some~~

PRE

Breakdown tasks
Reviews mathematical ideas that support area
Use visuals / manipulatives
Use reminder charts
Review previous lesson before continuing (memory issues)
Teach and use calculator when necessary
Use of friendly numbers

POST

Explore manipulatives with each new concept
Start with open-ended problem
Encourage discussion
…
Review vocabulary
…

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Some Preliminary Findings

- Teachers move from more generic strategies for supporting students with learning disabilities to more inclusive, evidence-based strategies that are *good for all but necessary for some*.

PRE

Try to help them understand the problem they are trying to solve; what is being asked? Understand the problem before trying to solve, focus on process not just final product / answer

POST

Provide many different learning activities

Varied strategies to solve problems

Lots of visual and multiple representations

Word wall and review of ideas from previous class

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Some Preliminary Findings

- We are developing a typology of collaboration

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Typology of Levels of Collaboration

between Mathematics and Special Education

Entry Level of Collaboration

- Little or surface dialogue between teacher of mathematics and special education
- IEPs contain generic accommodations; lack clarity, consistency and alignment
- Shared expectation that students with learning disabilities will struggle with engagement in the mathematics
- Isolation strategies in effect:
  - Student is withdrawn for core resource support (not linked directly to classroom teacher and program)
  - Alternate lesson, with modifications if listed in IEP
  - Isolated forms of student work, often paper pencil reflecting rote learning / practice

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Typology of Levels of Collaboration

between Mathematics and Special Education

Deep Level of Collaboration

- Immediate, precise and ongoing feedback between teachers (of math and special education)
- Revisions to IEPs to ensure clarity, consistency and alignment
- Shared interest in student engagement
- Integration strategies in effect:
  - Full integration in mathematics learning within classroom (no withdrawal, accommodations maximized) with direct support from special education personnel
- Shared understandings about prioritizing student math talk
- Depth of thinking about mathematics learning

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Myth or Truth?

- Students with learning disabilities DO have average intelligence.
  - They have average to above average intelligence
- Students with learning disabilities are NOT generally lazy.
  - Their issues are often related to the way in which their brains process information.
- With effort, most students CANNOT out-grow their learning disabilities.
  - While the specific causes of learning disabilities are debated, it is clear that learning disabilities, *once they manifest themselves, are always present*.
- Accommodations listed in individual education plans give students with learning disabilities an unfair advantage [in mathematics].
  - Accommodations are seen as helping to “level the playing field” for people with learning disabilities.

http://www.adnetonline.org/.cWtools/download.php/mnF=LD%20Myths%20Facts.pdf,mnOD=LD%20Resources,mnOD=Learning%20Disabilities,mnOD=Topics,mnOD=Information,mnOD=HTML,mnOD=My%20Documents,dc=adnet,dc=mennonite,dc=net

Thank You

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